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These results are strongly suggestive that the formations and extinctions of "Revival" groups are dependent on the manner in which the Sun is presented to the Earth, for the Central Meridian has no significance except in relation to the Earth. This feature, however, Mrs. Maunder * has already shown to be characteristic of all spots considered as a whole. From a thorough discussion of material, including the numbers and areas of all spot groups in the cycle 1889–1901, she discovers "a well-marked and steady preponderance of the eastern half of the Sun's disc over the western half, both as to the areas of the spots and as to the numbers of the separate groups." This phenomenon, shown also by the faculæ † and by prominences in general, ‡ suggests, as has been pointed out, a damping effect on spot formation exerted by the Earth, though it is difficult to see how this can arise. It is of interest that this apparent effect is shown in a marked way by the "Revival" groups. Firstly, they are indicative of some of the main centres of activity. Secondly, they may be considered as representing latent spot activity for part of their life-history. If any Earth effect exist, it is probable that it would be operative on them in a greater degree than on groups of more intense and continuous activity. It is desirable to extend the examination of "Revival" groups to other years, and this note is therefore offered tentatively until a fuller discussion can be undertaken.

Royal Observatory, Greenwich:
1922 *January* 4.

Solar Motion from 1922 *Radial Velocities.*

By George Forbes, M.A., F.R.S.

Voûte's First Catalogue of Radial Velocities bears evidence of sound judgment in its compilation, and, in any case, it affords an opportunity for deriving the amount and direction of the solar motion based upon a greater number of stars than any previous attempt.

A preliminary survey of + and – values greater than the solar velocity is very suggestive. Omitting the 138 nebulæ, ten clusters, and one star (Barnard's) with "very discordant values," there remain 1922 radial velocities, out of which 697 have velocities greater than a solar motion of ·20 km./sec. Any concentration of +'s and –'s among these stars must therefore be quite independent of a solar motion of 20 km./sec. or less. A chart of these 697 high-velocity stars shows a great concentration of + radial velocities from galactic longitudes 110°, through 180°, to 270°. It contains a large oval patch about 90° diameter, containing 197 plus, and only four minus, stars. The opposite hemisphere is full of minus stars with very few plus ones. It also contains an oval patch, even more condensed, containing 205 minus, and only 19 plus, stars. The centre of minus concentration may be at galactic longitude 30°, latitude +10°. The centre of plus concentration in galactic latitude –10° to –20°, longitude uncertain, perhaps

* *M.N.*, 67, 460 and 471.

† *M.N.*, 80, 738.

‡ *M.N.*, 67, 472. *Kodaikánal Bulletin*, Nos. 28, 35, 67.

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180°. These concentrations are not affected by a solar motion of 20 km./sec., yet they indicate a general stream of stars, Kapteyn's stream I. in fact. The conclusion is that the prevalent motion is better described as a stream of stars, with every grade of velocity, than as a controlling solar motion, and that the solar velocity derived from any observations will be found to vary with every list of stars used for the purpose.

In further illustration of the tendencies exhibited by high-velocity stars, a free curve can be drawn on the chart, dividing the sky into two nearly equal parts. There is only one part of the boundary line where pluses and minuses are mixed, and 34 pluses appear in the minus hemisphere. Neglecting these local, boundary exceptions, 607 of the stars, having radial velocities over 20 km./sec., are travelling in directions from the minus hemisphere to the plus hemisphere; only 56 in the opposite direction. Now, this excess is absolutely independent of any solar velocity of 20 km./sec. or less. Table I. gives all the information required for further examination of this point.

In deducing the solar motion from this catalogue of radial velocities, the method used by Campbell in his *Stellar Systems* has been followed exactly with one exception:—no rejection of any stars has been adopted with the hope of thus attaining a closer value of the solar motion *relatively to the centre of gravity of our sidereal system.* Any such rejection must be arbitrary, and is not necessarily conducive to the purpose with which the rejection is made.

Galactic co-ordinates are used throughout with galactic pole at R.A. $12^{h}\ 40^{m}$; n.p.d. 62°; 0° long. at $18^{h}\ 40^{m}$. Table II. shows the algebraic mean radial velocity and number of stars for each section (20° × 20° except at the poles) in one hemisphere, together with those for the corresponding section in the other hemisphere (signs reversed).

w = weight attached to each section. = number of stars in the section.
α = galactic longitude of the section.
δ = galactic latitude of the section.
V = mean radial velocity in that section.

$$\mathrm{A} = \sqrt{w} \,.\, \cos\alpha \,.\, \cos\delta. \qquad \mathrm{B} = \sqrt{w} \,.\, \sin\alpha \,.\, \cos\delta$$
$$\mathrm{C} = \sqrt{w} \,.\, \sin\delta \,. \qquad \mathrm{D} = \sqrt{w} \,.\, \mathrm{V}.$$

72 equations resulted of the form

$$\mathrm{A}x + \mathrm{B}y + \mathrm{C}z = \mathrm{D},$$

where

$$x = \mathrm{V}_0 \,.\, \cos\alpha_0 \,.\, \cos\delta_0,$$
$$y = \mathrm{V}_0 \,.\, \sin\alpha_0 \,.\, \cos\delta_0,$$
$$z = \mathrm{V}_0 \sin\delta_0,$$

$\mathrm{V}_0, \alpha_0, \delta_0$ giving the solar motion relative to 1922 stars included in the investigation.

From these 72 equations the usual three normal equations of the method of least squares were deduced. Their solution gave

$$\mathrm{V}_0 = 22{\cdot}00 \text{ km./sec.}$$
$$\left.\begin{array}{l} \alpha_0 = 20^\circ\ 50'; \\ \delta_0 = +20^\circ\ 15'; \end{array}\right\} \text{ or } \begin{array}{l} \text{R.A.} = 18^{h}{\cdot}0 = 270^\circ. \\ \text{Decl.} = +27^\circ. \end{array}$$

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TABLE I.—High Velocity Stars. (Over 20 km./sec.)

Average + positive radial velocities, and number of stars.

Galactic Longitudes.

Galactic Latitude.	280°.–260°.	260°.–240°.	240°.–220°.	220°.–200°.	200°.–180°.	180°.–160°.	160°.–140°.	140°.–120°.	120°.–100°.	100°.–80°.	80°.–60°.	60°.–40°.	40°.–20°.	20°.–360°.	360°.–340°.	340°.–320°.	320°.–300°.	300°.–280°.
+90°–+60	51 (1)	— —	47 (2)	— —	— —	— —	— —	65 (1)	24 (1)	— —	— —	— —	26 (2)	— —	— —	— —	— —	22 (1)
+60–+40	— —	— —	— —	69 (2)	30 (3)	46 (5)	29 (3)	25 (2)	23 (1)	— —	— —	— —	— —	— —	30·5 (2)	52·7 (3)	— —	— —
+40–+20	— —	28 (2)	38 (5)	26 (5)	34 (11)	23 (4)	30 (8)	40 (5)	— —	— —	29 (4)	— —	— —	— —	34 (2)	98 (1)	— —	31·7 (3)
+20–0	25 (3)	24 (1)	31 (5)	31 (8)	56 (4)	34 (6)	28 (8)	44 (3)	— —	20·5 (2)	29·7 (4)	— —	— —	27 (1)	68 (2)	37 (1)	— —	24 (2)
0–−20	26·6 (5)	26·4 (13)	41·3 (10)	39 (14)	39·7 (10)	31 (21)	29·7 (7)	38·6 (5)	35 (3)	— —	— —	— —	34 (1)	— —	25 (1)	22·3 (3)	26 (2)	— —
−20–−40	— —	32 (9)	26 (8)	83 (9)	61 (7)	26 (5)	58 (15)	35 (2)	58 (2)	29 (1)	— —	— —	33 (1)	— —	22 (3)	28 (3)	67 (4)	60 (2)
−40–−60	24 (1)	40 (9)	28 (3)	39 (5)	28 (4)	45 (3)	50 (5)	47 (5)	— —	— —	45 (1)	— —	40 (2)	— —	33 (1)	31 (2)	26 (1)	26 (1)
−60–−90	— —	37 (2)	27 (1)	20 (2)	20 (1)	25 (2)	— —	— —	29 (1)	— —	— —	— —	— —	22 (2)	— —	25 (2)	26 (2)	— —

Average − negative radial velocities, and number of stars.

Galactic Latitude.	280°.–260°.	260°.–240°.	240°.–220°.	220°.–200°.	200°.–180°.	180°.–160°.	160°.–140°.	140°.–120°.	120°.–100°.	100°.–80°.	80°.–60°.	60°.–40°.	40°.–20°.	20°.–360°.	360°.–340°.	340°.–320°.	320°.–300°.	300°.–280°.
+90°–+60	35 (1)	— —	29 (2)	— —	29 (1)	— —	39 (4)	97 (1)	— —	— —	— —	24 (1)	39·3 (3)	41·5 (2)	— —	39 (1)	24·5 (2)	54 (1)
+60–+40	37 (2)	34 (1)	57 (1)	25 (1)	29 (2)	— —	24 (1)	28 (2)	— —	52 (3)	46 (1)	30·3 (3)	69·6 (8)	29·9 (7)	39·4 (5)	70 (1)	70 (1)	29·5 (2)
+40–+20	— —	22 (2)	— —	— —	— —	— —	138 (2)	35 (2)	28 (2)	30 (2)	28 (5)	31 (4)	49·7 (13)	29·0 (8)	61·7 (8)	55·5 (6)	24 (3)	39 (1)
+20–0	45 (2)	— —	— —	— —	— —	— —	25 (2)	44 (3)	33 (3)	65 (5)	32·6 (12)	43·5 (13)	34·9 (28)	40·1 (11)	46·6 (5)	38·6 (5)	28·9 (9)	42·7 (4)
0–−20	22 (1)	— —	— —	— —	39 (1)	— —	190 (1)	23 (1)	35·7 (4)	62·4 (14)	29·1 (8)	46 (10)	30·8 (10)	43·4 (8)	38 (5)	33·7 (4)	28 (4)	30 (1)
−20–−40	— —	— —	— —	— —	34 (1)	42 (1)	— —	— —	49 (4)	46 (6)	30 (3)	37 (3)	44 (5)	21 (1)	72 (4)	83 (2)	30 (1)	22 (2)
−40–−60	— —	— —	— —	— —	21 (1)	— —	23 (2)	41 (1)	34 (1)	33 (3)	30 (2)	39 (2)	— —	55 (2)	32 (2)	30 (1)	38 (1)	— —
−60–−90	— —	— —	30 (1)	— —	— —	20 (1)	— —	33 (1)	41 (2)	29 (1)	— —	31 (2)	26 (1)	— —	— —	— —	— —	— —

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TABLE II.—All stars, excluding clusters and nebulæ. Average radial velocities (+ and −) for each 20° × 20°, including radial velocities (− and +) in the corresponding section in opposite hemisphere; and number of stars in each section.

Mean Galactic Longitude.

	270°.	250°.	230°.	210°.	190°.	170°.	150°.	130°.	110°.
+70°	− 3·5 (19)	− 6·6 (9)	+ 8·5 (15)	+ 1·9 (14)	−14·4 (10)	− 4·0 (7)	−15·7 (16)	−11·1 (13)	+0·9 (11)
50	+ 0·6 (23)	− 1·0 (15)	+ 0·9 (17)	+ 2·8 (17)	+10·2 (18)	+12·1 (21)	+ 2·2 (31)	− 0·2 (23)	+0·4 (14)
30	+ 9·7 (25)	+ 5·7 (23)	+13·4 (23)	+14·0 (26)	+18·1 (24)	+13·3 (29)	+ 2·6 (30)	− 0·2 (24)	+4·7 (27)
10	+14·9 (60)	+11·2 (40)	+19·5 (35)	+14·4 (48)	+22·4 (27)	+ 9·4 (38)	+ 7·5 (44)	+ 1·1 (40)	−3·7 (30)
−10	+14·9 (38)	+14·1 (55)	+22·5 (53)	+25·4 (68)	+21·6 (41)	+19·0 (49)	+ 6·3 (48)	+12·5 (46)	+2·2 (45)
30	+ 5·4 (17)	+11·5 (31)	+15·3 (33)	+47·4 (31)	+22·3 (26)	+19·1 (32)	+28·0 (44)	+10·1 (30)	−5·5 (38)
50	+14·1 (19)	+18·1 (25)	+13·8 (16)	+35·4 (26)	+16·4 (21)	+17·2 (20)	+ 6·5 (24)	+19·7 (18)	+4·0 (19)
70	+ 3·3 (10)	+12·2 (13)	+ 6·0 (9)	+20·6 (11)	+12·1 (13)	+ 3·3 (12)	+ 7·8 (9)	+18·4 (7)	+3·6 (12)

The Slide-Rule as an Auxiliary to the Solution of Kepler's Equation.

By Major A. E. Levin.

In the following method the ordinary slide-rule is used to give, by direct reading, a first approximation, which is usually within two or three minutes of the rigorous value. It may also be used with advantage in the subsequent corrections.

(*a*) *Approximate Solution.*—The equation, with M and E both expressed in degrees, takes the form $M = E - 57{\cdot}29 \ldots . e \sin E$. If then the slider be reversed, so as to have the trigonometric scales uppermost and the right-hand end of the sine scale be set on the value $57{\cdot}29 \ldots . e$, previously found either by logarithms or by ordinary multiplication on the front of the slide-rule, we shall have, for any assumed value for E on the sine scale, the corresponding value of $57{\cdot}29 \ldots . e \sin E$ on the upper scale. It is then easy to pick out a value of E such that the readings of the two scales differ by the given value of M. In practice it is convenient to effect the setting directly by the trigonometric scale by employing the approximation $57{\cdot}29 \ldots . e = \frac{e}{\sin 1^\circ}$ (correct to 1 in 19700). Or, for values of e above 0·5, we may set 2° on the sine scale against $2e$ (formed mentally), which gives an approximation still within the limits to which the scale can be read. This latter method has the advantage that the right-hand end of the slider is within the limit of the upper scale, so that readings up to $E = 90°$ and above may be taken at a single setting.

If the eccentricity be given by ϕ, the eccentric angle, the scale may be set by putting sin 1° against 1 of the fixed scale and reading $\frac{\sin \phi}{\sin 1^\circ} = 57{\cdot}29 \ldots . e$ by means of the cursor, afterwards setting the end of the sine scale to the position so held.